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A3

(12) # EUROPEAN PATENT APPLICATION

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(54) **Apparatus and method for controlling mass flow rate in rotary compressors.**

(57) Two sets of guide vanes (52) and (62) are positioned in the combustion air flow path (54) in the inlet duct (50) of a rotary compressor (10) of a gas turbine engine for controllably varying the air mass flow rate according to turbine load conditions. The upstream set (62) which provides a fixed, initial degree of swirl relative to compressor rotational direction and axis (18) and the controllably moveable downstream set (52) which provides a final degree of swirl cooperate to provide controllable swirl over the range of about 0° to 32° in the inlet air incident upon the compressor blades (16). The two guide vane sets (52) and (62) are separated by a distance sufficient to allow turbulence induced by the first set (62) to fully decay before the second set (52) is encountered.

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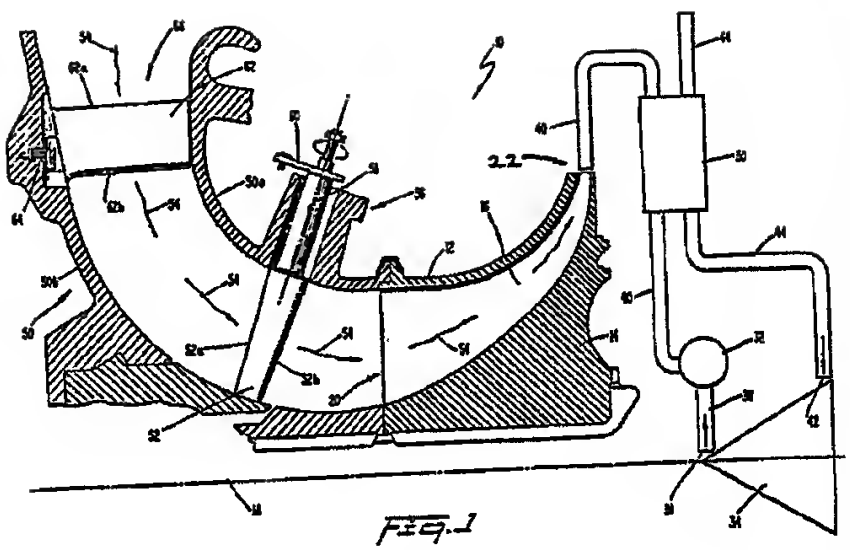

FIG. 1

European Patent Office

EUROPEAN SEARCH REPORT

0072701
Application number

EP 82 30 4336

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl ³)
A	FR-A- 868 713 (BAJ) *Page 3, lines 25-35; figure 6*	1,15	F 04 D 29/46 F 04 D 27/02
A	DE-A-2 502 986 (KOTZUR) *Page 4, lines 7-15; figures 1-4*	1,15	
A	DE-A-2 458 273 (KRONOGAARD) *Page 1, line 4; figures 1-4*	14,25	

TECHNICAL FIELDS SEARCHED (Int Cl ³)

F 04 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26-11-1982	WOOD R.S.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503 03.82

[Translation from German]

(51) Intl. Cl.[2]: **F 04 D 29/44**
F 04 D 27/00

(19) **FEDERAL REPUBLIC OF GERMANY**
GERMAN PATENT OFFICE

(11) **Letters of Disclosure 2,502,986**

(21) Serial No.: P 25 02 986.1

(22) Application date: January 25, 1975

(43) Disclosure date: July 29 1976

(30) Union Priority: (32) (33) (31) --

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(54) Title: **Device for Adjusting Rotary Blades**

(61) Supplementary to: P 24 03 113.8

(71) Applicant: Gutehoffnungshütte Sterkrade AG, 4200 Oberhausen

(72) Inventor: Joachim Kotzur, 4200 Oberhausen

GUTEHOFFNUNGSHÜTTE STERKRADE
Aktiengesellschaft

2,502,986

42 Oberhausen, January 23, 1975

PA-Sch. H/Ri
2330 (2299)

Device For Adjusting Rotary Blades

(Supplementary to Patent Application P 24 03 113.8).

Device for differentially coupled adjustment of two rows of rotary blades, situated one after another in the flow direction and mounted on rotary blade shafts of a turbocompressor, in which it is possible, via gears located on the rotary blade shafts and by means of an adjustable toothed ring shared by them, to adjust the inclination angles of the rotary blades of the two rows of rotary blades in a differentially coupled fashion because the gears of the rotary blade shafts have different diameters, as recited in Patent Application P 24 03 113.8.

In the parent application, the content of which is hereby expressly referred to and which in this respect, should be considered part of the present application, the figures show only a radial flow through the rows of rotary blades. Preferably, the rotary blade rows can also be used in a non-radial arrangement.

The object of the present invention, therefore, is to apply the inventive teaching of the parent application also in particular to a floating arrangement of the impeller. This object is attained according to the present invention in that the rows of rotary blades are situated one after another in the flow direction, axial to the direction of the rotor axis and the flow passes through them in a partially or completely axial direction.

In another embodiment that is not shown, the rows of rotary blades can also be acted on in an intermediate position by a radial/axial mixed flow and their arrangement can then assume any desired angle in relation to the rotor axis.

In other words, this is an intermediate position between a radial and an axial arrangement.

Another object of the present invention is to also avoid the disadvantages of the prior art mentioned in the parent application for an axial and/or floating arrangement of the rows of rotary blades.

An exemplary embodiment of the present invention will be described in detail below in conjunction with the drawings.

Fig. 1 is a schematic partial section through a turbocompressor according to the present invention,

Fig. 2 is a view of the arrangement of rotary blades positioned according to the present invention,

Fig. 3 is a schematic partial section through rotary blades that are axially arranged and through which the flow passes in an axial direction, and

Fig. 4 shows the section A – A according to Fig. 3, with an alternative neutral position of the blades or a pre-rotated position.

It is clear that the rotary blade shafts 3 and 4 are supported in swiveling fashion in housing parts of the compressor; according to Fig. 3, the shaft axis extends in the

radial direction. The gears 5 and 6 of different diameters are adjusted by means of a shared toothed ring 7, which can be rotated coaxially with the rotor.

The diameters of the gears 5 and 6 are to be selected in accordance with the desired, different (differential) positions of the rows of rotary blades.

According to Fig. 4, the rows of rotary blades situated one after another constitute a profile, which in the neutral position lies with the rotary blades situated one after another precisely in the flow direction and therefore has the least amount of resistance and which, with an increasing degree of adjustment, generates an increasing flow deflection, without the possibility of a separation since the rotary blades 2, which are situated further downstream and have the more intense deflection, are supplied with the flow that has already been pre-deflected by the rotary blades 1 upstream of them.

In order to shift the separation threshold toward significantly higher deflection angles of the flow, according to the present invention – as has been explained above, an additional rotary grid is placed before the rotary grid normally provided, thus distributing the overall deflection angle to two grids. In the example of use, the individual rotary blades of the two grids are equipped with gears that are driven by a shared toothed ring.

The transmission ratios of the gears are selected so that the adjustment angle of the rotary grid 2 situated closest to the impeller leads the other grid 1 by such an amount that the deflection angle is distributed to the two rotary grids in accordance with a predetermined ratio.

January 23, 1974 [sic]

Claims

1. A device for differentially coupled adjustment of two rows of rotary blades, situated one after another in the flow direction and mounted on rotary blade shafts of a turbocompressor, in which it is possible, via gears located on the rotary blade shafts and by means of an adjustable toothed ring shared by them, to adjust the inclination angle of the rotary blades of the two rows of rotary blades in a differentially coupled fashion because the gears of the rotary blade shafts have different diameters, as recited in Patent Application P 24 03 113.8, characterized In that the rows of rotary blades (1, 2) are arranged one after another In the flow direction, axial to the direction of the rotor axis (axial through flow).

2. The device as recited in claim 1, characterized in that the rows of rotary blades (1, 2) are arranged one after the other in the flow direction, radial to the direction of the rotor axis (radial through flow).

3. The device as recited in claim 1 and 2, characterized in that the two rows of rotary blades are adjusted by respective toothed rings, each of which is able to be actuated independently of the other or at a particular ratio in relation to the other.

[Text in Fig. 4:] Section A-A

Neutral position

Pre-rotated position

Fig. 1

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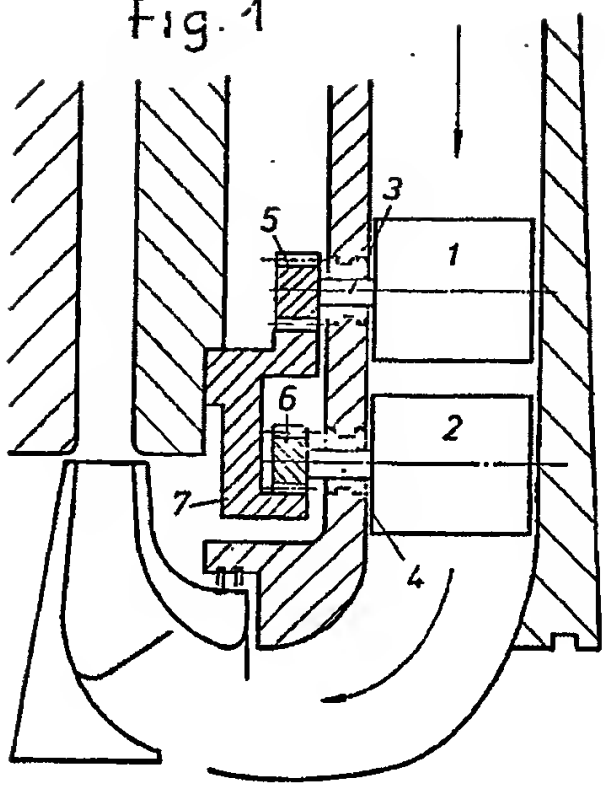
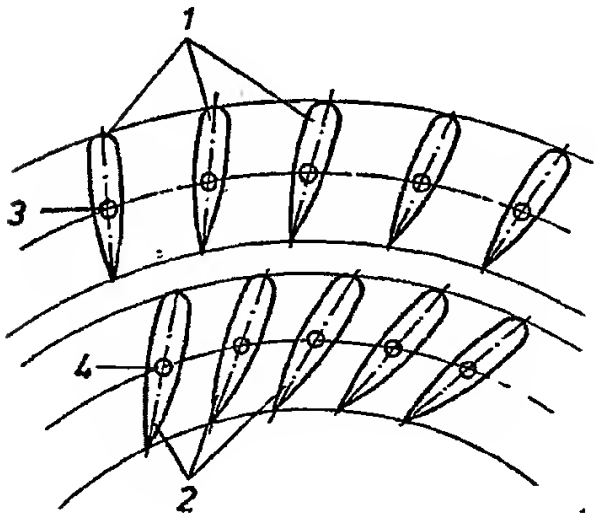


Fig. 2



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F04D 29-44 AT:25.01.1975 OT:29.07.1976

Fig. 3

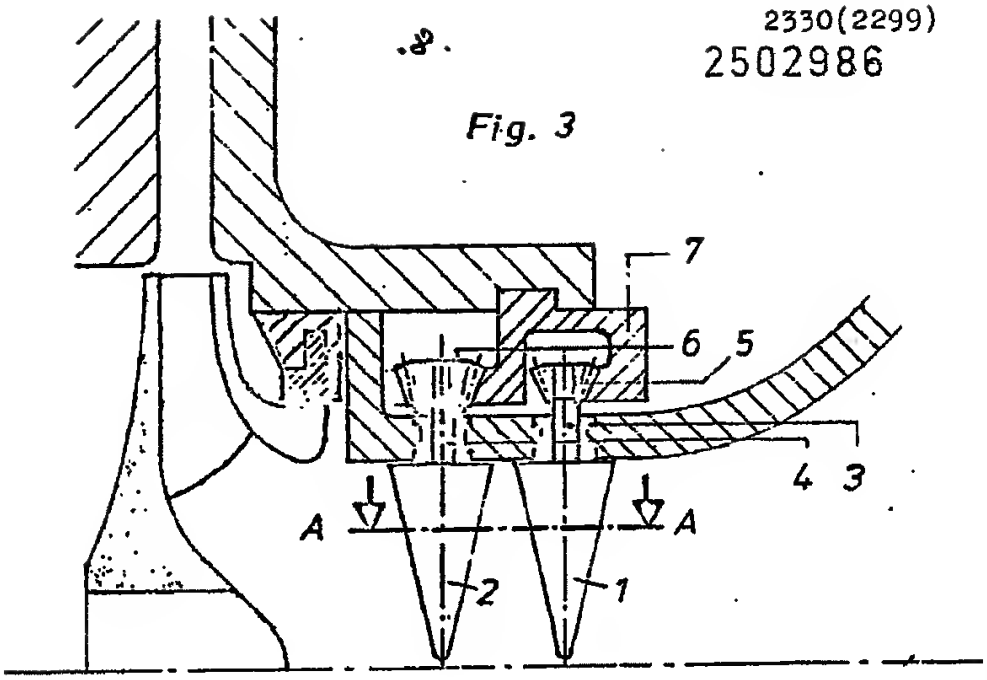
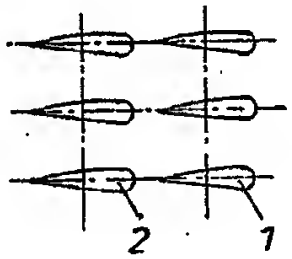


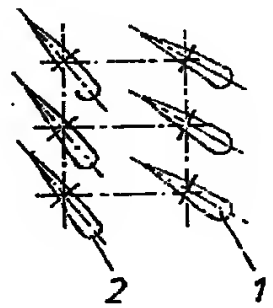
Fig. 4

Schnitt A-A

Neutralstellung



Vordrall



PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
NdP/89054		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP2004/014775	22/12/2004	29/12/2003
Applicant		
NUOVO PIGNONE HOLDING S.P.A.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the *language*, the *international* search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
      [ ] The international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
   b. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. [ ] **Certain claims were found unsearchable** (See Box II).

3. [ ] **Unity of invention is lacking** (see Box III).

4. With regard to the title,
   [X] the text is approved as submitted by the applicant.
   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,
   [X] the text is approved as submitted by the applicant.
   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the drawings,
   a. the figure of the drawings to be published with the abstract is Figure No. 1
      [ ] as suggested by the applicant.
      [X] as selected by this Authority, because the applicant failed to suggest a figure.
      [ ] as selected by this Authority, because this figure better characterizes the invention.
   b. [ ] none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2004/014775

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F04D29/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F04D F01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 072 701 A (A/S KONGSBERG VAPENFABRIKK) 23 February 1983 (1983-02-23)	1-4
Y	page 6, line 26 - page 9, line 7	1-3
Y	figure 1	5-7
Y	US 3 799 694 A (DUZAN J,US) 26 March 1974 (1974-03-26) column 2, line 51 - column 3, line 2; figure 1	1-3
Y	US 5 460 484 A (YAGI ET AL) 24 October 1995 (1995-10-24)	5-7
A	column 3, line 12 - line 54; figures 1,2	1,3,4

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 March 2005	21/03/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Di Giorgio, F

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2004/D14775

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 25 02 986 A1 (GUTEHOFFNUNGSHUETTE STERKRADE AG; M.A.N. MASCHINENFABRIK AUGSBURG-NUER) 29 July 1976 (1976-07-29) page 3, paragraph 4 - page 4, last paragraph; claim 1; figure 1	1,3-5
A	US 3 442 493 A (LEROY H. SMITH JR) 6 May 1969 (1969-05-06) column 2, line 65 - column 3, line 10; figure 1	1,3

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP2004/014775

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0072701 A	23-02-1983	US 4428714 A	31-01-1984
		DE 3267805 D1	16-01-1986
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